



Lewkowich Engineering Associates Ltd.
geotechnical • health, safety & environmental • materials testing

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Richard and Cheryl Schellinck
P.O.Box 4, Merville, B.C.
Merville, B.C.
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Attn: Mr. Richard Schellinck

**PROJECT: STRATA DEVELOPMENT OF DISTRICT LOT 208,
SAYWARD DISTRICT, QUADRA ISLAND, B.C.**

SUBJECT: PRELIMINARY GEOTECHNICAL ASSESSMENT

Dear Mr. Schellinck:

1. Introduction

- a. At your request, Lewkowich Engineering Associates Ltd. (LEA) has carried out a preliminary geotechnical assessment of the above site. This report provides a summary of our findings and recommendations. Specifically, our evaluations have taken into account those natural hazards, which may affect the safe development of the land.
- b. We examined the Official Community Plan (OCP) to determine whether the proposed development lies within any Environmentally Sensitive Area (ESA), Natural Hazard Area (NHA) or Development Permit Area (DPA). We note that this site is located within three development permit areas including Environmentally Sensitive Area, Steep Slope Area, and Water Course, as shown on the Site Plan by Thorconsult Ltd. (their drawing number BT09-B dated March, 2009).

2. Background

We understand that the 64 hectare, country residential development will include a mixed use of residential buildings that may include up to two-three storey structures of typical construction consisting of a steel or wood-framed superstructure supported on a concrete footing foundation. Our steep slope assessment will supplement the RAR completed by Mr. Ken Bond (QEP Technician).



3. Assessment Objectives

Our assessment, as summarized within this report, is intended to meet the following objectives:

- i. Determine whether the land is geotechnically safe and suitable for the intended purpose, where “safe” is defined as a probability of a failure of 10 percent in 50 years, with the exception of a slope failure related to a ‘design’ seismic event where a probability of occurrence of 2 percent in 50 years is considered safe;
- ii. Identify any geotechnical deficiency that might impact the design and construction of the development with attention to designated OCP areas, and prescribe the geotechnical works and any changes in the standards of the design and construction of the development that are required to ensure the land, buildings, and Works and Services are developed and maintained safely for the use intended; and
- iii. Acknowledge that approving officers may rely on this report when making a decision on applications for the development of the land.

4. Assessment Methodology

A site reconnaissance was carried out on May 13, 2009 to gather information on the topography and the stability of the rock formations as it relates to the latest conceptual plans. Sub-surface soils and bedrock geology maps were also referenced by our office in the area of the subject property. The report is preliminary in nature due to the visual only site investigation and the conceptual nature of the development.

5. Site Conditions

5.1. General

- a. The site of the proposed country residential development consists of a 65 hectare lot located near the southern end of Quadra Island. The site is bordered by a partially developed commercial (C-2) property to the west, by partially developed rural (RU-1) properties to the east, by Gowland Harbour to the north and by partially developed residential (R-1) properties to the south.
- b. Topography within this development is complex, with varying foreshore slopes in both degree (20 to 80 deg from horizontal) and height (4m to 30m) throughout. A relatively flat plateau



exists in the northern portion of the subject site with a moderately inclined section surrounding a small cove in the southern half of the property. The topography also includes a seasonal creek (Lone Fish Creek) at the bottom of a deep ravine located just south of Union Road that flows toward the small cove noted above. Overall the terrain can be described as gently rolling with some outcroppings of bedrock. The southwest and northwest extent of the property culminated at the foreshore by sheer cliffs in excess of 10m high.

- c. Vegetation consists of forested areas, including mature specimens along the outer perimeter, but the inland areas above union road have been extensively logged. Tree growth is a combination of fir, hemlock, western red cedar, and deciduous trees (maple and alder), with an undergrowth of ferns, berry vines and salal. Cleared areas include a thick growth of tall grasses with some low shrubs, blackberry bushes as well as immature tree growth.

5.2 Subsurface Conditions

- a. Typical subsurface conditions throughout the site include portions of exposed/shallow bedrock interrupted by areas of deep moraine sediments (which are generally thicker than 1m) over bedrock. The moraine sediments include pockets of colluvium and perched glaciofluvial materials. The bedrock is described as a dark grey, basaltic volcanic rock with an aphanitic surface texture. An examination of exposures indicates that the rock here is somewhat modified by tectonic action resulting in localized shear zones. The rock is characterized as strong and slightly weathered. The degree of jointing is rated as moderate, but with no dominant pattern. Where overburden soils overlie the bedrock, there is relatively little weathering of the bedrock surface. However, the bedrock surface can be described as having intricate and strong relief due to differential weathering along shears and localized joints. Much of the exposed bedrock areas include steep gradients to the foreshore below ranging in height from 10 to 30m.
- b. Much of the subject area has thicker deposits of soil. These soils are predominantly post-glacial soils typically granular in texture. An underlying formation of glacial till - identified as a mixture of silt, sand and gravel with traces of clay and frequent cobble to boulder sized materials - are typically thin in nature where exposed and/or inferred. Some testpits have been excavated for the soils investigation to determine septic design. These testpits, located on the upper plateau area showed a primarily sand based material to a depth in excess of 2m.



5.3 Groundwater

Ground water conditions within anticipated building envelope areas are generally expected to be favorable for site development. We did not observe any water seepage or evidence of a shallow water table. In general, we expect that the ground water table will have a strong seasonal component, with ground water flows resulting from “perched” conditions notably above glacial till soils, as well as bedrock. Groundwater levels can be expected to fluctuate seasonally with cycles of precipitation. Groundwater conditions at other times and locations can differ from those observed at the time of our assessment.

6 Conclusions & Recommendations

6.1 General

- a. Based on the investigation in the preceding Section 5, the site is considered geotechnically safe and suitable for the intended purpose (residential development), provided the recommendations in this report are followed.
- b. Site development for the study area is understood to require area grading (excavation and embankment construction) to establish proposed roadway and service line installations. Therefore, lots are subject to re-examination during and after area grading but prior to development registration. We have taken this issue into account in formulating our recommendations.
- c. Building areas within the study area are subject to a number of controls, including coastline buffers and riparian setbacks, which we have taken into account in establishing “no build” areas for geotechnical reasons. That is, we have assumed that construction would not be permissible in these areas and have not considered development further. Controls pertaining to wildlife protection areas or vegetation controls have not been discounted, since such areas could be considered in future.
- d. We recommend that setbacks from steep slope crests be provided for proposed structures as a precautionary measure against slope degradation due to erosion from extreme storm events or from seismic action. In general, since this site has portions that consist of shallow or exposed bedrock, slopes that require setbacks are considered to have an inclination exceeding 30 degrees



from horizontal. Based on an examination of slopes within this development site, we conclude that there are natural slopes within the property that require setbacks from slope crests. Where buildings are set above rock slopes such as in Areas 1 and 2 (Drawing BT 09-B-02, Rev 1), a minimum setback of 8m is recommended. Where buildings are to be set above glacio-marine sediment slopes as noted on Drawing BT 09-B-02, Rev 1 (Area 3) a minimum set back equal to the height of the foreshore or ravine slope is required. The Geotechnical Engineer may consider modification of the setback distances, subject to an evaluation of site-specific condition.

- e. Subgrade conditions within those areas inside of the geotechnical "build" areas are considered to be favorable for residential building construction. In general we expect that an allowable bearing pressure of 150 kPa would be available for building design and construction. This would be suitable either for naturally deposited soils, bedrock, or structural fill. If foundations consist of intact bedrock, a higher allowable bearing pressure should be available. Site preparation shall include removal of any organic (topsoil) materials or unengineered fill soils.
- f. Settlements for foundations constructed on the combination of bedrock, native undisturbed soil, or compacted structural fill should be within those ranges considered to be normal and tolerable for wood frame residential housing, being: 20 to 25 mm total and 10 to 15 mm differential between typical column spacings. This is contingent on removals of any loosened or disturbed soils within footing areas, according to conventional and good construction practice.
- g. Fill, if required to raise building areas above existing grades, should consist of freely draining imported sand and gravel. Rock rubble fill material may also be used, but is not considered practicable except in areas of bulk filling, since its compaction requires relatively heavy equipment for adequate densification. Granular fill, where required for structural support, shall be compacted to a minimum of 95 percent of the maximum Modified Proctor dry density (ASTM D 1557).
- h. Fills may be created to establish building levels that differ from existing conditions. In this case, a setback of 3.0 metres shall be established for fills ranging from 1.5 to 3.0 metres high,



and 5.0 metres where the fill exceeds 3.0 metres thick. Fill slopes shall not exceed an inclination of 2.0 Horizontal: 1.0 Vertical. Fill shall be compacted to achieve a uniform and dense relative density. Structural fill shall be evaluated and be approved by the Geotechnical Engineer for the project.

- i. Natural soil cut faces shall not be undercut without subsequent support by permanent retaining walls designed and constructed to support the slope face. In general, retaining wall back slopes should be flattened to a configuration no steeper than 2 H: 1 V to allow for disturbance such as from temporary excavation. The Geotechnical Engineer for the project should review temporary sub cutting such as for retaining or foundation walls deeper than 1.5 metres. A more detailed geotechnical analysis on a lot by lot basis may be necessary at the time of construction this may be accomplished using a standard BC Building Code Quality Assurance Schedule's B and C.

6.3 Erosion Control

Since the site consists of some erodible surfaces, erosion control is expected to be an issue of significance during the development of this property. Overland storm water controls should take into account the potential impact of concentrated runoff as it may impact adjacent sensitive areas. This should generally take the form of runoff from construction activities being directed to retention areas prior to entry to sensitive areas. Erosion control plans can be provided by our office prior to any construction activities to ensure appropriate BMP's are documented.

6.5 Seismic Issues

No liquefiable soils have been identified at this site, nor are any expected below the investigation depth. Consequently, no unusual seismic design requirements have been identified for this site. Much of the site includes areas of shallow bedrock, which would then fall under Site Class A as applicable to Table 4.1.8.4.A of the 2006 B.C. Building Code for structures directly supported by bedrock. However, other areas of the site include competent naturally deposited soils which would fall under Site Class C as applicable to Table 4.1.8.4.A of the 2006 Building Code, for the purposes of foundation design and construction, unless detailed site observations confirm that the site class can be upgraded.



6.6 Permanent Dewatering

- a. Considering the nature of the subject area subgrade materials, we currently expect that no special precautions are required beyond conventional perimeter drainage tile as outlined in the current B.C. Building Code. Piping entering buildings established at elevations below roadways should be installed in a manner that precludes excess moisture injection to building subgrades. These details include providing trench dams for municipal service piping installed with granular bedding, and drains on electrical or other conduits. Conventional requirements of the B.C. Building Code pertaining to building drainage are considered suitable at this site. Once final plans and tentative elevations are determined, the Geotechnical Engineer should be consulted and provide further dewatering data
- b. Ground surfaces should be graded to direct surface water well away from buildings. Any settlement of backfill around foundations will create undesirable low areas for collection of surface water next to the building, and should be immediately corrected by placement of additional backfill to restore proper surface drainage away from buildings. Settlement of backfill should not be a problem if backfill is placed and compacted following our recommendations regarding structural fill.

7.0 Geotechnical Assurance and Quality Assurance

The BC Building Code requires that a Geotechnical Engineer be retained to provide Geotechnical Assurance services for the construction of buildings. Geotechnical Assurance services include review of the geotechnical components of the plans and supporting documents, and responsibility for field reviews of these components during construction.

8.0 Acknowledgements

Lewkowich Engineering Associates Ltd. acknowledges that this report may be requested by the building inspector (or equivalent) of the Regional District of Strathcona as a precondition to the issuance of a development permit. It is acknowledged that the approving officers and building officials may rely on this report when making a decision on application for development of the land.



We acknowledge that this report has been prepared solely for, and at the expense of Rick & Cheryl Shellinck. We have not acted for or as an agent of the Regional District of Strathcona in the preparation of this report.

9.0 Limitations

The conclusions and recommendations submitted in this report are based upon the data obtained from a limited subsurface investigation (visual). The nature and extent of variations within this subsurface exploration may not become evident until construction or further investigation. The recommendations given are based on the subsurface soil conditions encountered during the site investigation, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is made. Due to the geological randomness of many soil formations, no interpolation of soil conditions between or away from the areas identified has been made or implied. If unidentified soils are encountered, unanticipated conditions become known during construction or other information pertinent to the structures become available, the recommendations may be altered or modified in writing by the undersigned.

10.0 Closure

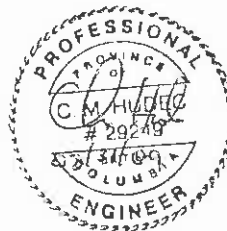
Lewkowich Engineering Associates Ltd. appreciates the opportunity to be of service on this project. If you have any comments, or additional requirements at this time, please contact us at your convenience.

Respectfully Submitted,
Lewkowich Engineering Associates Ltd.

A handwritten signature in black ink, appearing to read 'John Hessels', written over a light blue grid background.

John Hessels, ASCT
Senior Technologist

Reviewed by,



Chris Hudec, M.A.Sc., P.Eng
Project Engineer

